

no true meningitis, the virus has not been found in the spinal fluid, antibodies reach the brain and cord less easily through the spinal fluid than through the blood, and it is beyond doubt that such a procedure causes discomfort and actual danger to the patient.

The status of treatment of poliomyelitis with an antiviral serum can fairly be summarized with the statement that none of the arguments against its potential or proved value successfully demolish its rationale, and the opinions of numerous observers support its use in clinical grounds as cogent as those applying to many measures in current use in other infections. The crux of the whole question is, after all, not so much whether serum has proved its value as whether the method of treatment has any *promise* of value. Those who are interested in this form of therapy should continue entirely on an experimental basis, using very large doses of serum. This may not be practical routine, but is essential to the final status of this approach to therapy.

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DIAPHRAGMATIC HERNIA: RESULTS OF SURGICAL TREATMENT IN 210 CASES*

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II †

SURGICAL TREATMENT

DIAPHRAGMATIC hernia is primarily a mechanical condition, and the only treatment which will relieve the condition is operative repair or reconstruction of the abnormal opening in the diaphragm. The indications for surgical intervention and the methods and technique of surgical procedures depend on the type, situation, and size of the defect in the structure of the diaphragmatic muscle, the kind and amount of abdominal viscera involved in the hernia, and whether or not the viscera are enclosed in the hernial sac. I shall first describe the general surgical methods and then consider the special technique which is required in the surgical treatment of some types of hernia.

From the standpoint of treatment cases of hiatus hernia may be divided into three groups: in the

first group the hernia is small and is recognized roentgenologically, often during the course of a general examination, and causes few or no clinical symptoms. No treatment is indicated in this group of cases. The second group includes those cases in which the symptoms are moderate and the hernias are of moderate size; in many of the cases in this group, conservative treatment, such as regulation of diet and reduction of weight, is sufficient to relieve the symptoms. The third group includes those cases in which there is no response to conservative measures; in these cases the hernias usually are large, and in many cases, in my experience, there are complications, such as incarceration of the stomach or gastric erosion. In this group of cases the only treatment that assures relief of symptoms is operative repair of the hernia.

In all cases in which a third or more of the stomach is involved in the hernia, surgical intervention should be considered because the condition is progressive and usually becomes rapidly worse after the hernia has attained this size. Operation should be performed before severe incarceration, with consequent obstruction and traumatic lesions of the stomach, has occurred. The operative risk is increased by gastric retention, and the technical difficulties are enhanced by fixation of the stomach to the diaphragm and to the hernial sac within the thorax. In all cases in which the colon is involved in the hernia, early operation is necessary because of the danger of intestinal obstruction.

Other types of hernia, such as traumatic hernia or those in which there is a congenital absence of a portion of the diaphragm, should be treated surgically, because the colon and small bowel are usually involved in the hernia and there is great danger of intestinal obstruction. In cases of traumatic hernia it is best not to operate until the acute symptoms caused by the primary injury have subsided, if the patient's condition will permit this delay.

Interruption of the Phrenic Nerve.—Paralysis of the diaphragm, produced either by temporary or permanent interruption of the phrenic nerve, is of value as a procedure preliminary to radical operative repair of many different types of diaphragmatic hernia. It is a necessary procedure in the surgical treatment of partial thoracic stomach resulting from a congenitally short esophagus. In some cases in which radical operative repair is contraindicated, it may be used as a palliative measure. In most instances in which interruption of the phrenic nerve is utilized as a procedure preliminary to radical operative repair of the hernia, I prefer, first, to perform temporary interruption of the nerve by crushing it, because in many instances it may not be necessary for the paralysis to be permanent. Function is usually reestablished in three to six months. In cases in which reestablishment of function of the diaphragm is not desirable because of the danger of recurrence of the hernia, the paralysis can be made permanent by cutting or avulsing the phrenic nerve. As a procedure preliminary to radical surgical treatment,

*From the Division of Surgery, The Mayo Clinic, Rochester, Minnesota.

Read before the meeting of the California Medical Association, Del Monte, May 1-4, 1939.

† Part I was printed in June, 1939, issue, page 399.

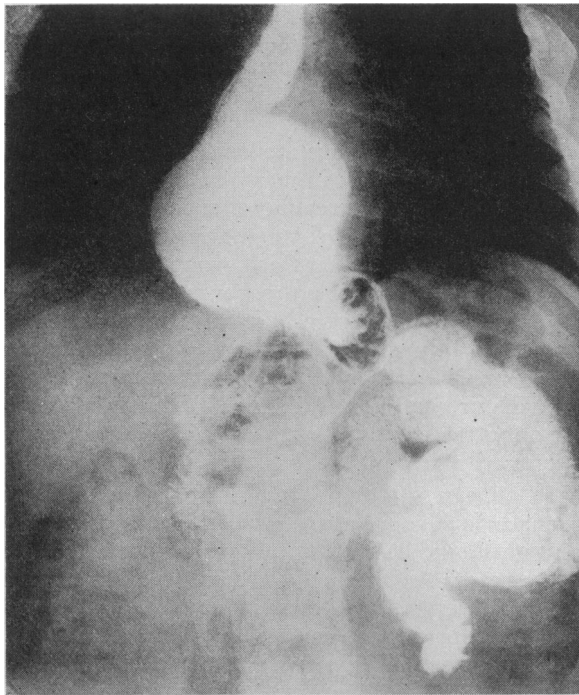


Fig. 1.—Esophageal hiatus hernia, with herniation of two-thirds of the cardiac end of the stomach into the posterior mediastinum, and extension into the right thoracic cavity. There is marked elevation and displacement of the esophagus to the right.

interruption of the phrenic nerve is often of value in the treatment of incarcerated and strangulated hernias because it prevents spasm of muscle and causes relaxation of the hernial ring. It is of great advantage in the closure of large hernial openings when there is considerable loss of structure of the diaphragm, as is usually found in traumatic or congenital hernias. The relaxation of the diaphragm following this procedure permits the structural defect to be closed without tension, and in cases of traumatic hernia in which the diaphragm has been torn from the thoracic wall it permits the diaphragm to be sutured to the intercostal muscles.

Interruption of the phrenic nerve may be utilized as a palliative measure in para-esophageal diaphragmatic hernia when the radical operative procedure of closure of the enlarged esophageal hiatus is contraindicated because of the patient's condition and when the stomach is the only abdominal viscus involved in the hernia. The purpose of this procedure is to prevent spasm of the diaphragm, which is the cause of the severe attacks of incarceration of the stomach in the hernial sac.

Phrenicotomy, as a sole procedure, does not completely relieve the symptoms. There is always a moderate amount of gastric distress immediately after, or shortly after the ingestion of heavy meals, but the patients get along rather well if they are careful with their diet. This procedure is not applicable to hernias in which a large portion of the stomach is in the thorax, causing marked pressure on the heart and lungs, nor is it applicable in any case in which the intestines are involved in the hernia. This procedure should not be employed when radical operative repair can be effected.

Radical Surgical Repair.

Anesthesia.—The method of administration of the anesthetic agent depends on the type of hernia which is present. In all cases in which there is no hernial sac, and in which there is a direct communication between the abdominal and thoracic cavities, I prefer intratracheal administration of the anesthetic agent by means of a positive pressure machine. In cases in which there is a hernial sac, as in the esophageal hiatus type of hernia, the anesthetic agent can be administered by the closed-mask method.

General Technical Considerations.—In the treatment of all hernias that have occurred through the left portion of the diaphragm, I prefer the abdominal approach by means of an oblique left rectus incision, starting at the ensiform cartilage and extending to the outer border of the rectus muscle. I believe there is less risk of thoracic complications when this approach is used. It is of particular advantage in cases of esophageal hernia, for the herniated stomach is usually confined in a sac in the posterior mediastinum and does not enter the true pleural cavity.

In hernias through the right diaphragm, I prefer the thoracic approach because the large, right lobe of the liver makes the abnormal opening in the diaphragm inaccessible from the abdominal approach.

The technical difficulties of adequate exposure of the hernial openings through the left portion of the diaphragm and the esophageal hiatus are often considerable because of fixation of the left lobe of the liver to the leaf of the diaphragm. The

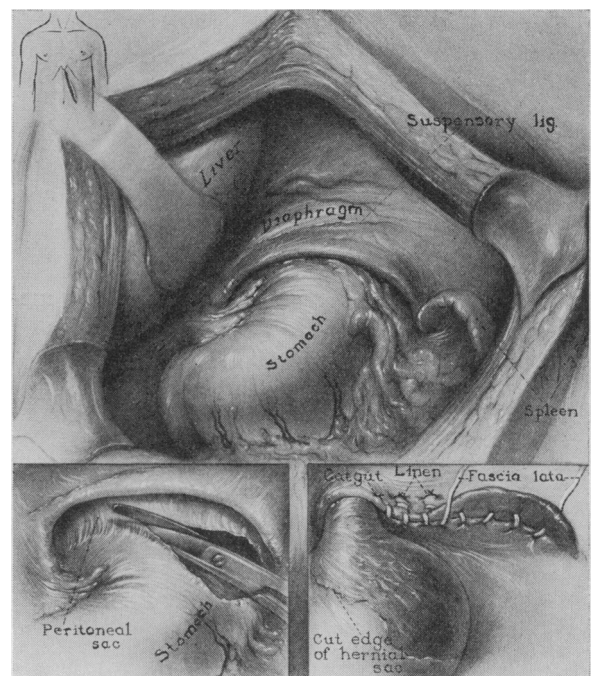


Fig. 2.—Drawing made at time of operation, showing traction on the liver after cutting left suspensory ligament. The upper insert shows the situation of the abdominal incision in the left rectus muscle. The lower inserts show the cutting of the peritoneal covering of the sac from its attachment to the stomach, and repair of the enlarged esophageal hiatus with continuous fascia lata and interrupted linen sutures, after replacement of the stomach in the abdomen.

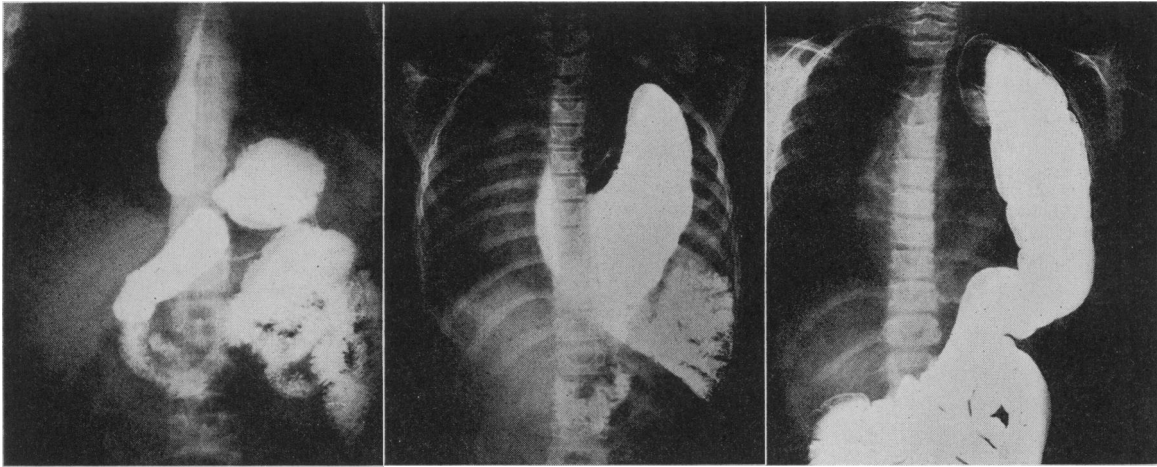


Fig. 3

Fig. 4

Fig. 5

Fig. 3.—Roentgenogram taken three weeks after operation, showing entire stomach in normal position below the diaphragm.

Fig. 4.—Roentgenogram taken on admission, showing entire stomach in left thoracic cavity and extending to the third rib.

Fig. 5.—Transverse colon herniated into the left thoracic cavity, extending to the apex.

exposure of these hernial openings is greatly facilitated by cutting the suspensory ligament and retracting the left lobe of the liver to the right. This can be accomplished, when the left lobe is small, by folding it on itself, and when it is large, by retracting it forward into the wound. The spleen is often very adherent to the posterior part of the diaphragm and hernial openings, but usually can be separated from these structures by blunt dissection. In some instances the spleen has been so traumatized by the injury, and bound into its abnormal position by adhesions, that it cannot be separated from the hernial opening without seriously injuring it. This not uncommonly occurs in the traumatic types of hernia, but occasionally in esophageal hiatus hernias. In these cases splenectomy is necessary.

Esophageal Hiatus Hernia.—Hernias through the esophageal hiatus are true hernias and have a hernial sac. The attachment of the sac to the stomach must be separated and the sac either completely removed or permitted to retract into the posterior mediastinum. I believe that this is one of the most important technical considerations in the surgical treatment of these hernias.

After the sac has been removed, the enlarged esophageal hiatus is repaired by overlapping the margins of the opening. Closure is usually made to the left of the esophagus, but in some cases it is necessary to close, partially, both to the right and left of the esophagus. In a few instances the enlargement of the esophageal opening is posterior, extending to the spinal column and requiring the overlapping of the margins posterior to the esophagus. In such cases, the condition is often thought to be a herniation through the aortic opening, but extending over the aorta there usually is an imperfectly developed, fibrous band which is the margin of the defective esophageal hiatus. The closure is usually made with living sutures of fascia lata which are removed from the thigh. The overlapped margins of the hernial opening are

first stabilized with interrupted linen sutures. The fascia lata is then woven into the tissues by continuous suture and fixed in the tissues with interrupted linen sutures.

In many cases in which the stomach is incarcerated, or obstructed, it is impossible to pass a stomach tube into the obstructed loculus of the stomach before operation. In these cases it is

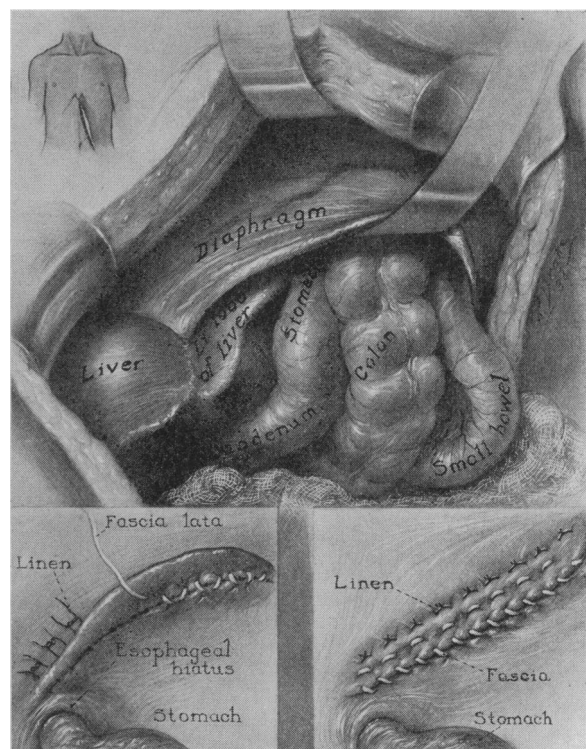


Fig. 6.—Drawing at time of operation, showing large laceration of left diaphragm. There is herniation of the entire stomach, transverse colon, many loops of small bowel and the left lobe of the liver into the left thoracic cavity. The lower inserts show the repair of the large laceration of the diaphragm, with continuous fascia lata and interrupted linen sutures, after replacement of the herniated abdominal viscera in the abdomen.

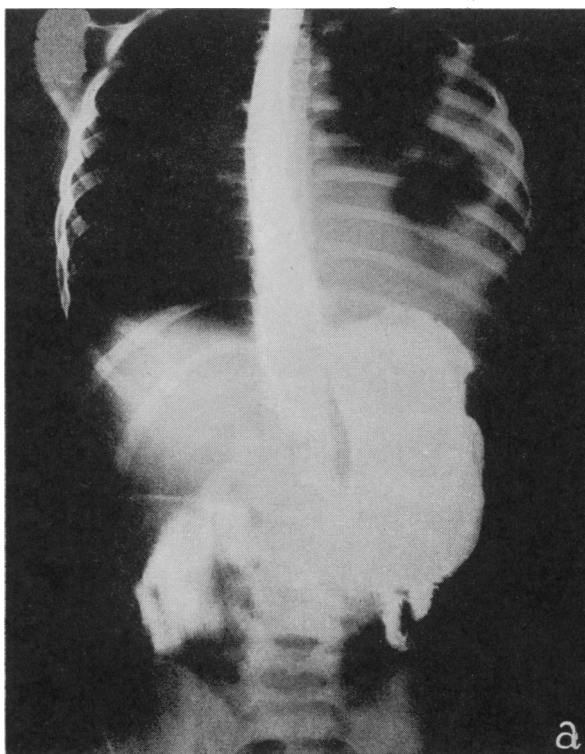


Fig. 7a

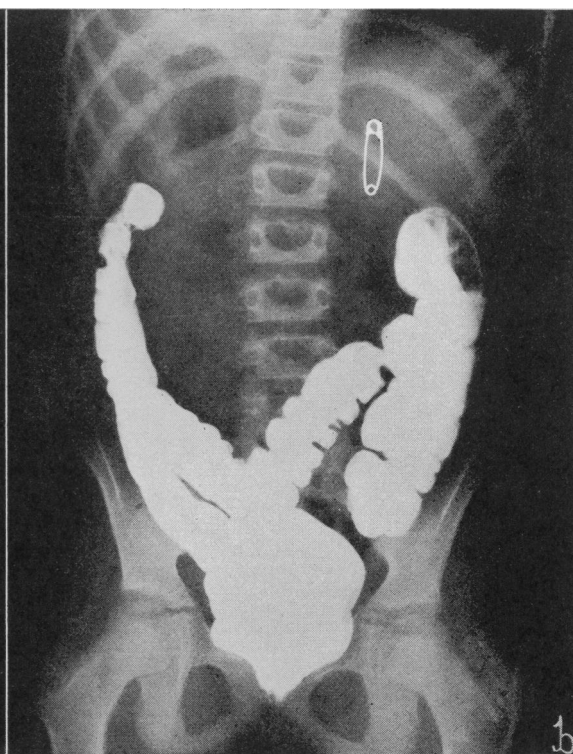


Fig. 7b

Figs. 7a and 7b.—Roentgenograms taken after operation, showing entire stomach and colon in normal position below the repaired diaphragm.

advisable to pass a stomach tube soon after the abdomen is opened, directing the tube into the obstructed portion of the stomach in order to empty the gastric contents before any attempt is made to reduce the herniated viscera, because of the danger of regurgitation and aspiration of gastric contents into the lung.

Before closure of the defective esophageal hiatus is completed around the lower part of the esophagus, it is important that a stomach tube of large caliber should be passed through the esophagus into the stomach, to aid in the reconstruction of the normal esophageal opening and to prevent constriction of the esophagus by a tight closure. A small portion of the esophageal wall is incorporated in the innermost margin of the closure by a suture of chromic catgut.

Not uncommonly in these cases there is an associated traumatic erosion in the herniated portion of the stomach, along the lesser curvature, close to the cardia, and this erosion is often adherent to the margins of the hernial opening. Great care should be used in replacing the stomach in the abdomen, and in removing the sac from the stomach because of the danger of perforating this thinned-out portion. In cases in which the ulcerated portion is penetrated, it should be repaired immediately with continuous catgut and linen sutures.

The abdomen should always be thoroughly explored for any other lesion, particularly of the stomach or gall-bladder. In some cases it may be necessary to operate on other associated lesions. However, I do not believe it advisable to carry

out any additional surgical procedure at the time of repairing the hernia, unless it is imperative, but it is well to know whether the patient has gall-stones or any other lesion, in the upper part of the abdomen, which might account for subsequent symptoms. (Figs. 1, 2 and 3.)

Congenital and Traumatic Hernias.—In treatment of congenital and traumatic hernias that occur through the left part of the diaphragm, the abdominal approach previously described is used. There is rarely, if ever, a hernial sac and the abdominal viscera are in direct contact with the thoracic viscera. In cases of traumatic hernia the abdominal viscera may extend to the apex of the thoracic cavity, and are usually very adherent to both the abdominal and thoracic sides of the diaphragm, and to the structures within the thorax. The adhesions to the margins of the opening and to the under surface of the diaphragm are often very marked, and should be separated first. The adhesions to the structures within the thoracic cavity are separated from below upward by approaching them through the hernial opening. By the abdominal approach this can be accomplished with little danger of injury to the abdominal or thoracic viscera, because the definite relationship of the herniated structures can be established.

In cases in which there has been considerable loss of structure, or in cases in which the muscle has been torn from its attachment to the thoracic wall, the defect in the diaphragm should be repaired by fascia lata stabilized with linen sutures. I believe this to be the most satisfactory type of closure in all of these cases. In cases of traumatic

hernia in which the laceration is confined to the dome of the diaphragmatic muscle, it usually is advisable to repair the opening by lapping the anterior margin over the posterior margin of the opening. When possible, it is advisable to overlap the margins of the opening from 2 to 3 centimeters. In those cases in which the laceration splits the muscle of the esophageal ring, great care should be taken in repairing the esophageal hiatus. In those cases in which the laceration extends to the margin of the thorax, and in which the attachments of the diaphragm are torn from the thoracic wall, the repair is made not only by overlapping the laceration of the leaf of the diaphragm, but by resuturing the diaphragmatic muscle to the thoracic wall. This can be accomplished by suturing the diaphragmatic muscle to the intercostal muscles between the ribs and, when possible, it should span two interspaces, being fixed to the intercostal muscles with fascia lata and stabilized with interrupted linen sutures. In a few instances the relaxation of the diaphragmatic muscle caused by interruption of the phrenic nerve will not permit enough relaxation of the muscle for repair of the defect. In these cases the diameter of the thorax must be narrowed by resecting the lower ribs by thoracoplasty. It is usually not necessary to resect more than a few inches of the ninth and tenth ribs at the angles. Congenital hernias in which there is considerable loss of structure are repaired in the same manner.

In all of these cases in which there has been a direct communication between the abdominal and thoracic cavities, every effort should be made to reestablish the negative pressure within the pleural cavity by removing the air, and by expanding the lung before the opening in the diaphragm is closed completely. In some instances this cannot be accomplished until after the rent in the diaphragm has been closed. In some cases pneumothorax may push the mediastinum and heart to the opposite side, and cause marked embarrassment of respiration and circulation. In these cases it is imperative that the mediastinum be stabilized in the midline immediately by aspirating the air from the pleural cavity with a needle until the pressure is negative. In cases of congenital hernia in which the lung has been collapsed from birth, I do not think it is advisable to attempt forceful, rapid expansion of the lung, as this may lead to hyperventilation as a result of forcing a large amount of the lung, which had never before been active, to function. In these cases the patients are best treated by aspirating the air from the pleural cavity, and allowing the lung to expand gradually for a time. I think it advisable to make a roentgenogram before the patient leaves the operating table, so as to determine the amount of pulmonary expansion.

Before closing the abdomen, the herniated viscera should be thoroughly explored, to be certain that there has been no injury to a viscus or that there are no bands of adhesions which will interfere with the function of the abdominal viscera. In cases in which there has been considerable ob-

TABLE 2			
Radical repair of defect in diaphragm			185
Approach: Abdominal—183 Thoracic—2			
Preliminary interruption of phrenic nerve		105	
Preliminary extrapleural thoracoplasty		2	
Operations in conjunction with repair of hernia:			
Gastric resection for gastric ulcer (Polya)		1	
Closure of perforated gastric erosion		2	
Posterior gastro-enterostomy for gastric ulcer (1)		3	
Posterior gastro-enterostomy for duodenal ulcer (2)			
Splenectomy for tuberculosis (1)		3	
Traumatic injury (2)			
Appendicostomy for obstruction		1	
Interruption of left phrenic nerve (hiatus hernias)			
Palliative—7 Therapeutic—18			25
TOTAL			210
Operative deaths—9			
Recurrences: Traumatic hernias—0. Hiatus hernias—6.			
195 patients recovered from operation and were relieved of symptoms.			

struction of the large bowel it may be necessary to perform appendicostomy or colostomy at the time of operation. All patients are placed in an oxygen cabinet or in an oxygen chamber immediately after the operation. (Figs. 4, 5, 6 and 7a and b.)

RESULTS

Table 2 shows the method of repair of the diaphragmatic hernia, the necessary, associated operative procedures at the time of repair of the hernia, and the results of operation in 210 cases on which this paper is based.

As noted previously in this paper, twenty-three of these patients had undergone operations for the same complaint without relief of symptoms, but were completely relieved following repair of the hernia.

Of the six recurrences, all occurred in esophageal hiatus type of hernia. Three of the patients had recurrence of symptoms. In two cases the symptoms were severe enough to require secondary operation, which repaired the recurrent hernia and relieved the symptoms. The third patient had moderate symptoms which are not sufficiently severe to warrant operation. In the three remaining cases, the recurrences were discovered by roentgenologic examination. There was a slight protrusion of the cardiac end of the stomach through the esophageal orifice, but the patients did not have any clinical symptoms of recurrence, and surgical treatment was not deemed necessary. In the last 115 cases in which operation has been performed for diaphragmatic hernia, there have been only two operative deaths.

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